(12) UK Patent Application (19) GB (11) 2 293 221 (13) A

(43) Date of A Publication 20.03.1996

(21) Application No 9518082.4

(22) Date of Filing 05.09.1995

(30) Priority Data
(31) 08308116 (32) 16.09.1994 (33) US

(71) Applicant(s)
National Coupling Company Inc

(Incorporated in USA - Texas)

1316 Staffordshire Road, Stafford, Texas 77477, United States of America

(72) Inventor(s)
Robert E Smith III

(74) Agent and/or Address for Service
Gill Jennings & Every
Broadgate House, 7 Eldon Street, LONDON, EC2M 7LH, United Kingdom

(51) INT CL[6]
F16L 21/04 37/24

(52) UK CL (Edition O)
F2G G14A1 G14D G27

(56) Documents Cited
GB 0851383 A GB 0717702 A GB 0419129 A

(58) Field of Search
UK CL (Edition N) F2G G10A G10B G21A G4D G4G
INT CL[6] F16L 21/04 37/24 37/244 37/248 37/252 37/28

(54) Hydraulic coupling with axial preloading of seal

(57) A hydraulic coupling for use in undersea drilling and production operations is disclosed, having a male member (10) with radially extending projections or fins (49, 52) configured to be received in a female member (20) having corresponding grooves (84, 88) in its receiving chamber. Insertion of male member 10 into the receiving chamber of female member 20 allows fins 49, 52 of member 10 to enter grooves 84, 88 and leading face 45 of member 10 to engage a metal seal 105 located on shoulders 99 of female member 20 (see figure 3). Relative rotation of members 10, 20 by 90° causes fins 49, 52 to enter a helical channel 83, which is in communication with grooves 84, 88, and compresses axially the seal 105 between face 45 and shoulder 99 (see figure 4). This preloads the seal before the coupling is pressured up with hydraulic fluid. The rotation of the male member may be done manually or by remote actuation.

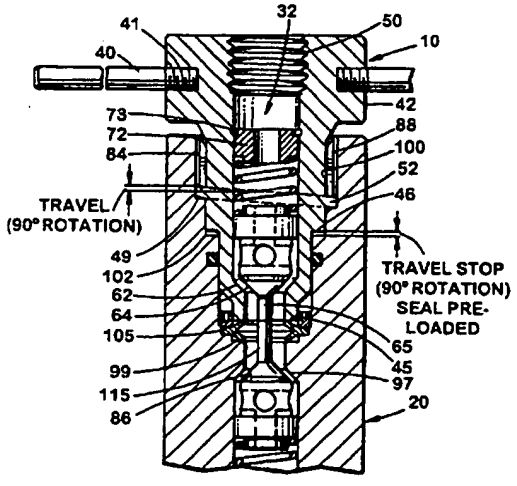


Fig. 3

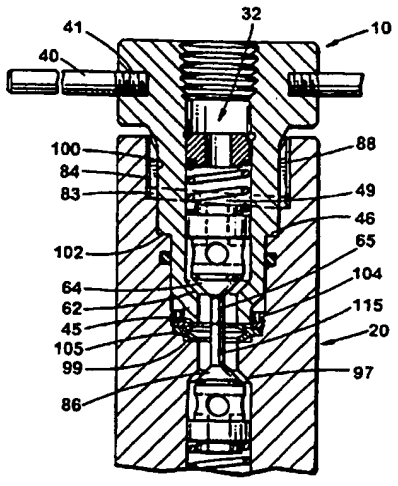


Fig. 4

GB 2 293 221 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1

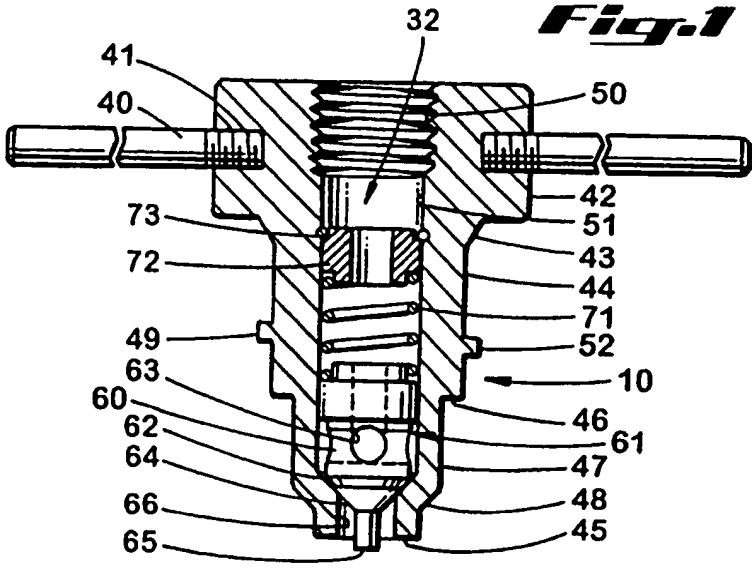
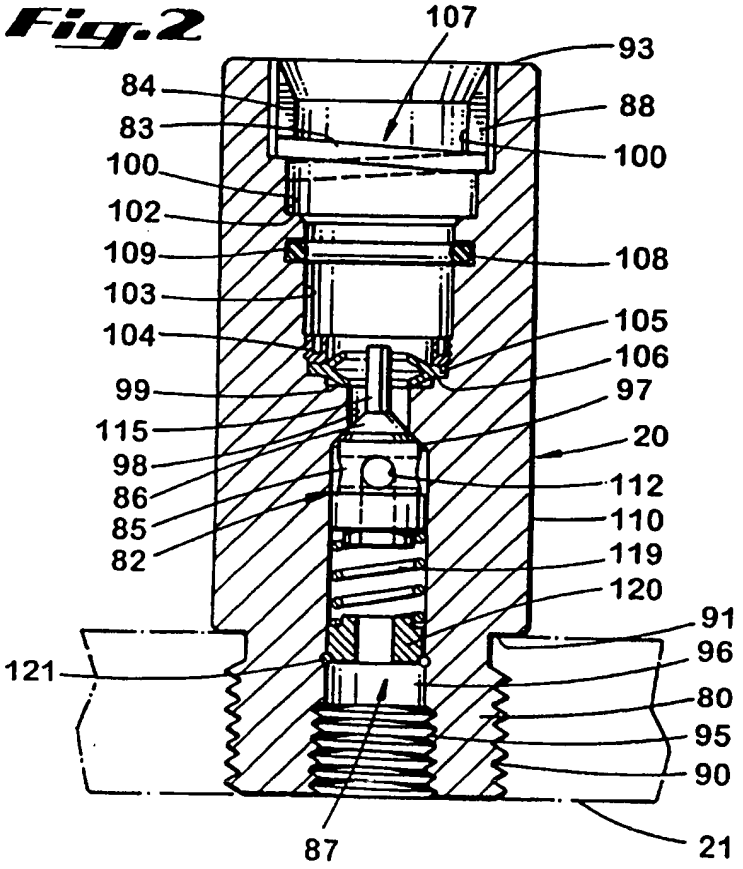

32
41
40
50
42
73
51
72
43
44
71
49
52
10
63
60
46
62
61
64
47
66
48
65
45

Fig.2


107
93
84
88
83
100
100
102
109
108
103
105
104
106
99
97
115
20
98
112
86
110
85
119
82
120
91
121
96
80
95
90
87
21

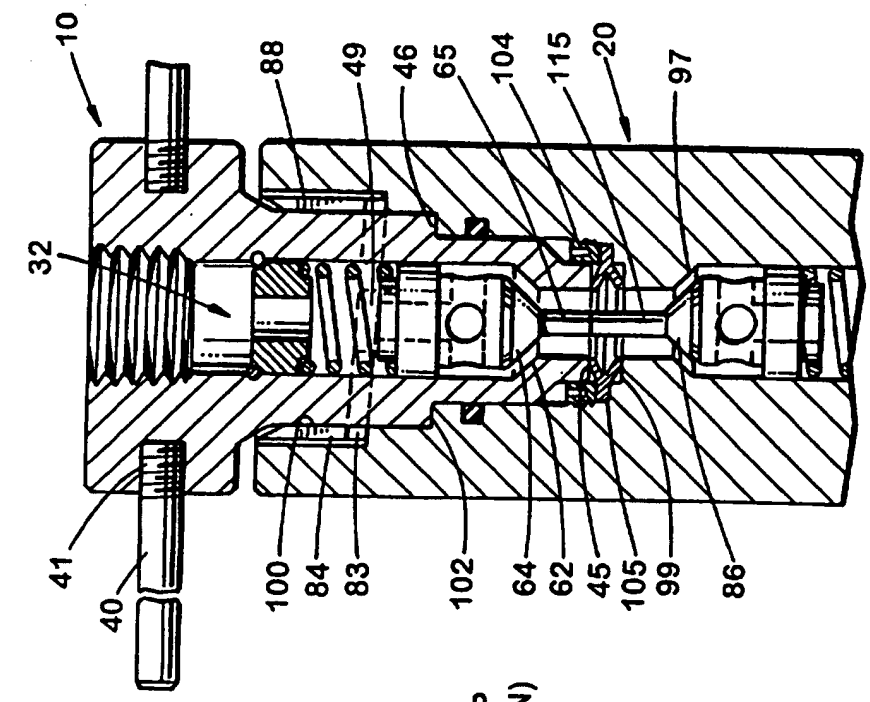

10
88
49
46
65
104
115
20
97
32
41
40
100
84
83
102
64
62
45
105
99
86

Fig. 4

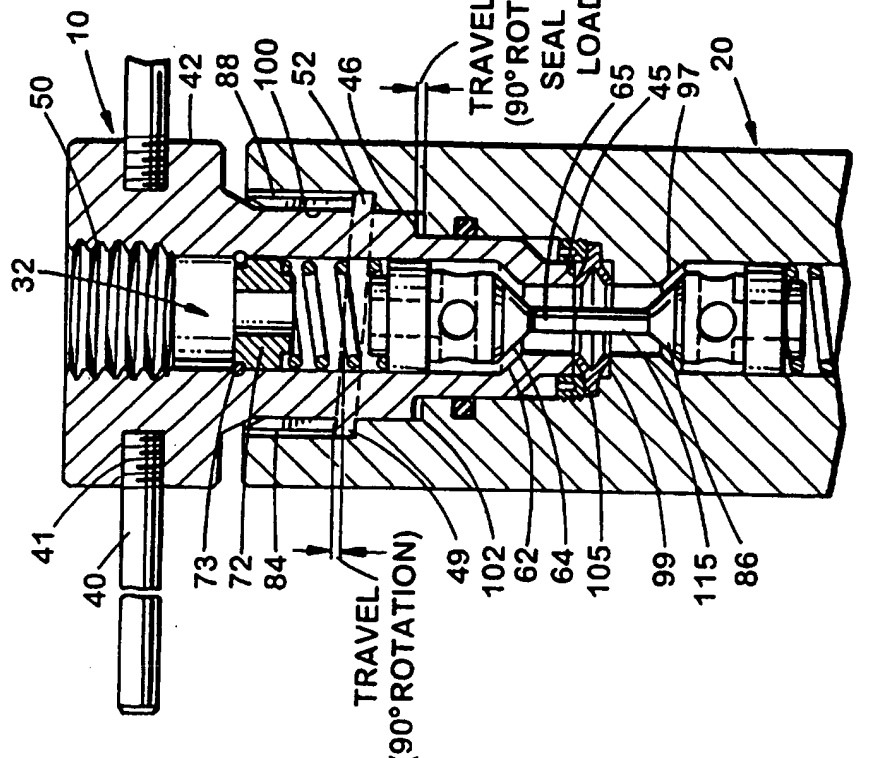

TRAVEL STOP
(90° ROTATION)
SEAL PRE-
LOADED
10
50
42
88
100
52
46
65
45
97
20
32
41
40
73
72
84
TRAVEL
(90° ROTATION)
49
102
62
64
105
99
115
86

Fig. 3

Fig. 5

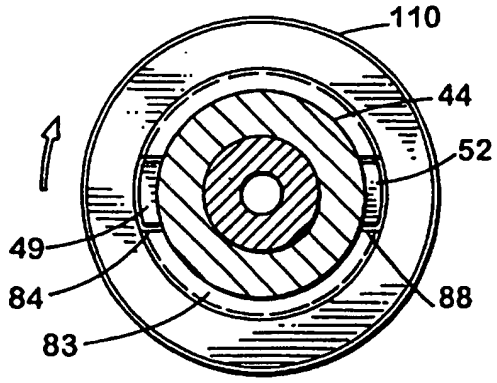
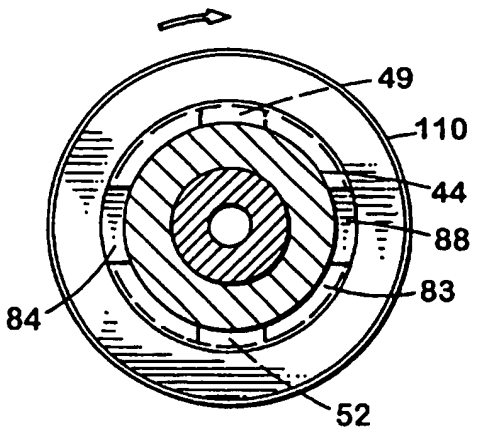


Fig. 6



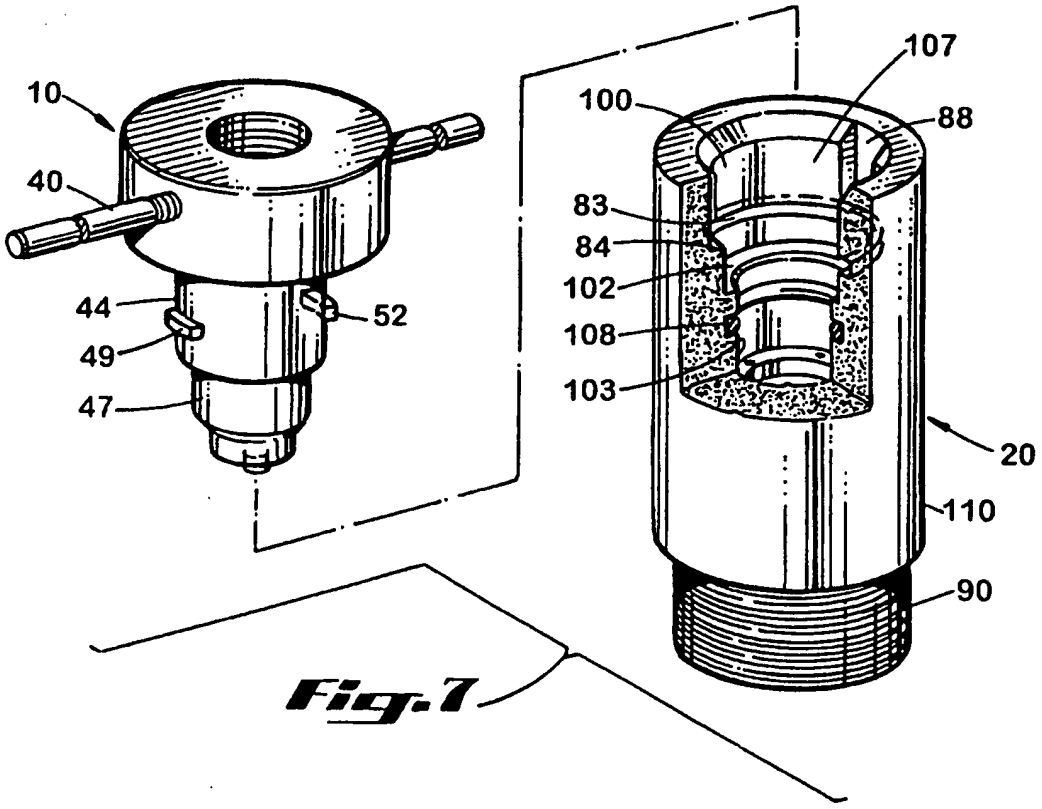


Fig. 7

2293221

UNDERSEA HYDRAULIC COUPLING WITH AXIAL PRELOADING

This invention relates in general to hydraulic couplings, and specifically to hydraulic couplings used in undersea drilling and production applications. More particularly, this invention involves a hydraulic coupling configured to urge the members together and axially compress a ring-shaped seal in the female member upon connection of the members.

The present invention resides in a hydraulic coupling of the foregoing type, including male and female members for fluid communication therebetween and a ring-shaped seal for sealing the junction between the coupling members. To lock the members together, and ensure that the seal is axially compressed to form a fluid tight seal between the members, the male member is cammed axially inwardly into the female member bore by rotation of the male member with respect to the female member. At least two fins or projections extend radially outwardly from the body of the male member and are captured in a groove in the female member bore which, during relative rotation of the members, urges the male member inwardly and axially compresses a ring-shaped seal in the bore. Preferably, the seal is a metal seal with a V-shaped cross section which is axially compressible between the face of the male member and a shoulder in the bore of the female member.

The male member contacts the seal before it is rotated, and then as it is rotated approximately 90

degrees, the male is brought further into the female member bore to slightly press against the metal seal and compress it. The male member may be rotated manually or actuated by mechanical means such as a cam.

Fig. 1 is a section view of a male member of a coupling according to a preferred embodiment of the present invention.

Fig. 2 is a section view of a female member of a coupling in a preferred embodiment of the invention.

Fig. 3 is a section view of a male member partially inserted into the female member of a coupling, before it is rotated to compress the seal.

Fig. 4 is a section view of a male member fully inserted into the female member with the seal compressed according to a preferred embodiment of the present invention.

Fig. 5 is a cross-section view of the coupling shown in Fig. 3 before the camming surfaces are rotated.

Fig. 6 is a cross-section view of the coupling shown in Fig. 4 after the camming surfaces are rotated.

Fig. 7 is a perspective view of the male and female members of the coupling.

The coupling of the present invention includes a male member 10 and a female member 20. As shown in Fig. 1, the male member 10 comprises a handle or flange 42, a tapered shoulder 43 and a cylindrical probe wall 44. In a preferred embodiment, the probe wall further includes a first shoulder 46, a reduced diameter probe wall 47, a second tapered shoulder 48 and a leading face 45.

The male member includes an internal bore 32 extending therethrough. At one end of the bore is a threaded passage 50 for connection to a hydraulic line. Adjacent and inboard of the threaded section is a cylindrical passageway 51 extending longitudinally within the male member body and terminating at valve seat 62 which is an inclined shoulder.

Adjacent the valve seat is cylindrical passage 66 having a reduced diameter.

As shown in Fig. 1, valve assembly 61 is slidably received within the central bore 32 of the male member. The various parts of the valve assembly of the male member are valve head 60 with apertures 63 extending therethrough, and valve face 64 which is conical in shape and dimensioned to seat within the valve seat 62 at the end of the male member bore. Extending from the valve face 64 is a valve actuator 65 which is cylindrical in shape and extends along the longitudinal axis of the male member. The valve actuator 65 is located at the apex of the conical valve face. Helical valve spring 71 is used to urge the valve face 64 into a closed position against valve seat 62. The helical valve spring is located within the cylindrical passageway 51 and anchored at hollow spring collar 72 which is held in place by collar clip at the inner surface of the cylindrical passageway 51. The opposite end of the helical valve spring 71 is in contact with the valve assembly, urging it into a closed position against the valve seat.

Extending radially outwardly form the probe wall 44 are projections or fins 49 and 52. In a preferred embodiment, two projections or fins are used. However, as will be apparent to those skilled in the art, additional projections or fins may be used to cam the male member axially into the female member bore or receiving chamber, as will be described in more detail below. Preferably, projection 49 is 180 degrees removed from projection 52, although the projections may be aligned or spaced as desired. As shown in Fig. 1, a rod 40 may be inserted into the handle 42 on each side of the handle with threads 41 or other attachment means. Such means may be used to manually rotate the male member when it is inserted into the female member. Other means for rotation may be used, such as mechanical means or cams.

Now turning to Fig. 2, a preferred embodiment of the female member of the present invention is shown. The female member 20 is attached to a manifold plate 21 so as to face the male member and align with it. The female member may be attached to the manifold plate using various means, such as set screws or threads. Techniques for attaching the member to a manifold plate are well known to those skilled in the art. The female member 20 comprises a handle 80, central bore 87 and a valve assembly 82. The handle 80 is optionally threaded to the manifold plate with threads 90. The female member also includes a shoulder 91 which is adjacent the threaded portion of the handle are the main cylindrical body 110, which terminates at female member face 93.

Central bore 87 has several variations in its diameter, as it extends through the body of the female member 20. At a first or outer end of the central bore is a threaded internal passageway 95 for connection to a threaded hydraulic line. The threaded portion 95 of the central bore terminates at cylindrical passageway 96 slidably receiving valve assembly 82. Cylindrical passageway 96 terminates internally at valve seat 97 for seating the valve face 86. Inboard of the valve seat 97 is narrowed bore 98.

The valve assembly 82 of the female member is substantially similar to the valve assembly of the male member and comprises a hollow valve body or head 85, with apertures 112 extending therethrough. Adjacent the cylindrical body is valve face 86 which is generally conical in shape for seating at the valve seat 97. Valve actuator 115 extends from the apex of the conical valve face and extends through passageway 98. To urge the female member valve assembly into the closed position, a helical valve spring 119 is mounted between the shoulder of the valve head 85 and spring collar 120 having collar clip 121 within passageway 96. The valve assembly 82 of the female

member and valve assembly 61 of the male member are generally identical in components and function. When each valve is an open position wherein the mutually opposed faces of the valve actuators 65 and 115 are in contact with each other, the helical valve springs exert insufficient force to keep the check valves in the closed position. The passageways for fluid communication between the male and female members then open to allow fluid flow between the members.

The female member, as shown in Fig. 2, further comprises a receiving chamber 107 configured to receive the male member therein. In a preferred embodiment, the receiving chamber 107 includes several variations in its diameter. Adjacent the face 93 of the female member, the first end 100 of the receiving chamber has its largest diameter. Positioned on each side of the first end 100 of the receiving chamber are axially slots 84 and 88 configured to receive the radial projections 49 and 52 of the male member. Slots 84 and 88 extend between the channel 83 in the female member and the face 93. Projections 49 and 52, as well as the groove 83 may be the same or similar to an interrupted stub acme type thread. The receiving chamber 107 further includes a shoulder 102 and a second diameter 103 which is preferably narrower than the first diameter 100. In a preferred embodiment, the second section 103 includes a circumferential groove 109 for receiving a seal therein, which preferably is an elastomeric O-ring 108. This seal serves as a back up seal to the metal seal 106 as will be described below.

The receiving chamber further includes shoulders 99 and 106 for annular ring-shaped seal 105. Annular seal 105 preferably is metal seal having a V-shaped cross section which is axially compressible. As shown in Fig. 2, one leg of the V-shaped seal seats against shoulder 99 and the opposing leg is configured to seal against the leading face 45 of the male member. In a preferred embodiment, the seal

is retained in the female member bore with use of retainer 104 which optionally may be threaded to the second diameter 103 of the female member receiving chamber. However, other means of retaining the seal in the female bore may be used, such as a lock ring captured in an internal groove in the receiving chamber.

Although a metal seal with a V-shaped cross section is shown in a preferred embodiment, it will be recognized to those skilled in the art that other types of axially compressible seals may be used. For example, a C-ring seal may be used to seal axially by compression against the face 45 of the male member, or against another surface such as a shoulder on the male member body. Alternatively, elastomeric seals may be used to seal against the leading face of the male member. The seal should be compressible axially to enhance its sealing effect. Therefore, seals having an internal cavity which may be pressure energized and compressible axially are preferred.

Now referring to Fig. 3, the male member is shown partially inserted into the female member according to a preferred embodiment of the present invention. In Fig. 3, radial projection or fin 49 has been fully inserted down axial slot 84 and radial projection or fin 52 has been inserted down slot 88. At this point, the male member may be rotated 90 degrees while the projections 49 and 52 are within groove 83. In Fig. 3, the end of the male member, leading face 45, has touched seal 105.

Now referring to Fig. 4, the male member has been rotated 90 degrees while projections 49 and 52 are within groove 83. At this point, the leading face 45 of the male member has compressed the seal 105 axially to preload the seal. The seal is compressed between the leading face 45 of the male member and the shoulder 99 in the female receiving bore.

In Fig. 5, a cross section of the male and female members is shown is the same position as Fig. 3. Prior to

rotation of the male member, projection 49 is within slot 84, and projection 52 is within slot 88. At this point, the male member may be rotated with both projections in groove 83. In Fig. 6, the members have been rotated 90 degrees relative to each other. This locks the male member to the female member, and axially compresses the seal 105 as described above.

In Fig. 7, a perspective view of the male and female members is shown. The male member 10 may be inserted into the female member receiving chamber 107 so that fins or radial projections 49 and 52 align with slots 84 and 88, respectively. Then, when the projections reach groove 83, the male member may be rotated to secure it to the female member and axially compress seal 105.

Although variations in the embodiment of present invention may not each realize all of the advantages of the invention, certain features may become more important than others in various applications of the device. The invention, accordingly, should be understood to be limited only by the scope of the appended claims.

CLAIMS

1. A hydraulic coupling comprising:

a male member having, a cylindrical body, an internal bore extending therethrough, a slidable valve to control fluid flow through the bore, and at least two projections extending radially outwardly from the cylindrical body; and

a female member having a body, two ends, a cylindrical bore extending therethrough, a slidable valve to control fluid flow through the bore, at least a portion of the bore dimensioned to slidably receive the male member body therein and having a ring-shaped seal engageable with the male member a body, at least one channel in the bore extending at least partially around the bore along a helical path, the channel dimensioned to receive each of the projections therein at which time rotation of the male member body with respect to the female member body brings the male member body into sealing engagement with the seal and at least two slots communicating between the channel and one end of the female member body, each of the slots dimensioned to allow insertion of the projections from the end of the female member body to the channel.

2. The hydraulic coupling of claim 1 wherein the seal is V-shaped in cross-section and is engageable with one end of the male member body.

3. The hydraulic coupling of claim 2 wherein the seal is axially compressible when each of the projections are in the channel and the male member body is rotated with respect to the female member body.

4. The hydraulic coupling of claim 1 wherein each of the projections extend at least partially around the male member body along a helical path.

5. The hydraulic coupling of claim 1 further comprising a seal retainer engageable with the female member and configured to hold the seal in place upon separation of the male and female members.

6. The hydraulic coupling of claim 1 wherein the slidable valves in the male and female members are poppet valves biased to the closed position and openable upon mutual engagement of valve actuators extending from the poppet valves.

7. A hydraulic coupling comprising:

(a) a female member having first and second ends, a bore with a normally closed valve for controlling the flow of hydraulic fluid between the first and second ends, a groove extending at least partially around the central bore in a generally helical direction, and at least two passages from the groove to the first end of the female member;

(b) a male member dimensioned to be insertable into the female member bore, the male member having a bore with a normally closed valve for controlling the flow of hydraulic fluid therethrough, and at least two fins projecting radially outwardly from the male member and dimensioned to be insertable into each of the passages; and

(c) an axially compressible ring-shaped seal in the female member bore, the male member being rotatable with respect to the female member when the fins are in the groove to urge the male member axially further into the female member bore and axially compress the seal against the male member.

8. The hydraulic coupling of claim 7 wherein the seal is a hollow metal seal.

9. The hydraulic coupling of claim 7 further comprising a circumferential shoulder in the female member bore for

limiting the axial movement of the male member into the female member bore.

10. The hydraulic coupling of claim 7 further comprising a retainer engageable with the female member for holding the seal in the female member bore upon separation of the male and female members.

11. The hydraulic coupling of claim 7 wherein the male member contacts the seal when it is inserted into the female member bore, and the groove in the female member bore is configured to limit the rotation of the male member to ninety degrees at which time the seal is compressed axially sufficiently to form a fluid tight seal between the male and female members.

12. A hydraulic coupling comprising:

(a) a valved male member having a stepped body progressively smaller in diameter from a first end to a second end thereof, and at least two fins projecting radially from the body;

(b) a valved female member having first and second ends, a stepped receiving chamber extending from the first end into the female member, the receiving chamber dimensioned to receive the male member body therein, the receiving chamber having a helical groove therein and a pair of slots extending axially between the groove and the first end of the female member;

(c) an annular seal positionable between one of the steps in the receiving chamber and one of the steps on the male member body, the seal being axially compressible chamber when the fins enter the groove and the male member is rotated to cam the male member further into the stepped receiving chamber.

13. The hydraulic coupling of claim 12 wherein the seal is a hollow metal seal that is V-shaped in cross-section.

14. The hydraulic coupling of claim 12 further comprising a seal retainer removably attached to the receiving chamber for retaining the seal adjacent one of the steps in the receiving chamber upon removal of the male member body therefrom.

15. The hydraulic coupling of claim 12 further comprising a second seal in the receiving chamber engageable with the male member body.

16. The hydraulic coupling of claim 15 wherein one of the first and second seals is engageable with the second end of the male member body and the other seal is engageable radially around the circumference of the male member body.

17. The hydraulic coupling of claim 12 wherein the seal is pressure energized whereby fluid pressure in the coupling urges the seal to expand against the male member body and the receiving chamber.

18. A hydraulic coupling substantially as described with reference to the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9518082.4
Relevant Technical Fields (i) UK Cl (Ed.N) F2G (G4D, G4G, G10A, G10B, G21A) (ii) Int Cl (Ed.6) F16L 21/04, 37/24, 37/244, 37/248, 37/252, 37/28	Search Examiner MR M SIDDIQUE Date of completion of Search 22 NOVEMBER 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-18

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 851383	(THE HANSEN) page 1 line 88 - page 2 line 5 at least; male member with projection 13 engageable in bayonet slots in female, valves etc	1, 7, 12 at least
Y	GB 717702	(MBG CORPORATION) valved male member engageable in valved female member via bayonet slots etc	1, 7, 12 at least
Y	GB 419129	(WHEATON) page 2 lines 85-114, sealing gasket 6 etc	1, 7, 12 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).